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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/691,274 10/22/2003 Thomas Werner 2000.105300 4933

23720 7590 03/26/2007  
WILLIAMS, MORGAN & AMERSON  
10333 RICHMOND, SUITE 1100  
HOUSTON, TX 77042

EXAMINER
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CHACKO DAVIS, DABORAH

ART UNIT	PAPER NUMBER
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1756

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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3 MONTHS 03/26/2007 PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

**Office Action Summary**

Application No.

10/691,274

Applicant(s)

WERNER ET AL.

Examiner

Daborah Chacko-Davis

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 09 January 2007.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-5,7-15 and 17-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5,7-15,17-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-5, 11-15, and 23-24, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,348,736 (McGahay et al., hereinafter referred to as McGahay) in view of U. S. Patent No. 5,610,105 (Vines et al., hereinafter referred to as Vines).

McGahay, in the abstract, in col 3, lines 63-67, in col 4, lines 1-46, discloses forming a low-k dielectric layer (SSQ, is a silicon-based dielectric layer) on a substrate, positioning the SSQ coated substrate in a plasma chamber and converting by plasma oxidation an upper portion of the SSQ layer to a silicon dioxide layer so as to form a thin oxide layer (cap layer), and patterning the thin oxide layer (sacrificial layer) and the low-k dielectric layer (SSQ layer), wherein the thickness of the thin oxide layer formed is designed so as to cause minimal damage to the underlying SSQ layer, and minimal increase in capacitance in the final structure (i.e., the cap layer and low-k layer corresponds to the desired design thickness). McGahay, in col 4, lines 1-10, discloses that plasma oxidation is performed in plasma chamber on the dielectric layer, and is heated throughout the process (beginning to the end till desired thickness is obtained, i.e., substrate with the dielectric layer is heated throughout the oxide formation process

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resulting in the forming of the cap layer on the upper portion of the dielectric layer), and is heated to at least 400°C, i.e., the volatile material present in the layers (dielectric and oxide layers and substrate) are out-gassed via the plasma chamber exhaust system (Precision 5000, by Applied Materials) (claims 1- 5, and 11-15).

The difference between the claims and McGahay is that McGahay does not disclose that the low-k dielectric layer is heat treated for a predetermined period of time after forming the low-k dielectric layer so as to promote out-gassing of volatile materials. McGahay does not disclose during heat treatment the pressure is maintained at less than about 1 Torr (claims 23-24).

Vines, in col 3, lines 43-67, and in col 4, lines 1-7, discloses that following the deposition the dielectric layer, the substrate with the dielectric layer is heat treated at a reduced pressure and elevated temperature (i.e., a vacuum bake), wherein the pressure during the vacuum bake is maintained below 1.0 Torr, and that the reduced pressure and elevated temperatures causes volatilization of undesired species (i.e., out-gassing of the volatile materials).

Therefore, it would be obvious to a skilled artisan to modify McGahay by employing the process of heat treating the substrate with the dielectric layer at the claimed pressure as taught by Vines because Vines, in col 4, lines 50-59, discloses that the anneal process performed on the dielectric layer provides a more reliable film with less tendency to exhibit a charging effect in the finished device.

3. Claims 7-10, and 17-22, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,348,736 (McGahay et al., hereinafter referred to as McGahay) in view of U. S. Patent No. 5,610,105 (Vines et al., hereinafter referred to as Vines) as applied to claims 1-5, 11-15, and 23-24, above and further in view of U. S. Patent Application Publication No. 2002/0090822 (Jiang et al., hereinafter referred to as Jiang).

McGahay in view of Vines is discussed in paragraph no. 2.

McGahay, in col 4, lines 1-1-54, and in col 5, lines 1-62, discloses forming a first resist mask over the sacrificial cap layer (thin oxide layer), and patterning the SSQ layer (low-k dielectric layer) to form a trench opening, forming a second resist mask over the thin oxide layer (even the exposed SSQ layer of the trench is further oxidized to form a thin oxide layer or cap layer) i.e., the patterned SSQ layered substrate is again plasma oxidized prior to second resist mask formation (forming a resist layer and patterning the resist layer to form a second resist mask) and heated (eliminates or out-gasses volatile material from the SSQ and oxide layers) to form a thin oxide layer in the bottom of the trench; patterning the SSQ layer through the second resist mask to form a via opening, wherein the trench has a greater lateral dimension than the via opening (claims 7-8, 10, 17-18, and 20).

The difference between the claims and McGahay in view of Vines is that McGahay in view of Vines does not disclose that the resist contamination is maintained below a specified level. McGahay in view of Vines does not disclose determining a

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contamination level of the photoresist or resist residuals prior to forming the first resist mask (claims 9, 19 and 21-22).

Jiang, in [0011], [0012], [0013], [0014], [0015], [0016], [0017], [0018], and [0028], discloses determining the resist poisoning (contamination level in the low-k dielectric layer), and eliminating or reducing the resist poisoning by a corresponding plasma oxidation treatment prior to resist mask formation.

Therefore, it would be obvious to a skilled artisan to modify McGahay in view of Vines by employing the suggestion of Jiang to determine the resist poisoning amount and reduce the poisoning amount in the low-k dielectric layers prior to further laminations or resist layer formations because McGahay, in col 3, lines 4-16, and in col 4, lines 37-46, discloses that the thin oxide formed on the SSQ dielectric layer is impervious and prevents any contaminants (any attack prevented) from reaching the SSQ dielectric layer, and Jiang, in [0016], [0017], [0018], [0028], and [0030], discloses that plasma oxidation of the low-k dielectric layer, along with heating, reduces resist poisoning at the via pattern level, and improves the exposure energy, by lowering the required exposure energy needed, for printing the target CD.

### ***Response to Arguments***

4. Applicant's arguments with respect to claims 1-5, 7-15, 17-24, filed January 9, 2007, have been considered but are moot in view of the new ground(s) of rejection.

A) Applicants argue that McGahay does not teach heat-treating the substrate after forming the low-k dielectric layer to promote out-gassing prior to the formation of the sacrificial cap layer.

McGahay teaches the formation of the sacrificial cap layer after forming the dielectric layer using a plasma oxidation process that includes heating the substrate with the dielectric layer in an oxygen-containing plasma ambient. Vines is relied upon to disclose heat treating the substrate after forming the low-k dielectric layer and prior to forming the cap layer, wherein the heat-treatment causes the volatilization of the undesired species i.e., the out-gassing of the volatile materials.

### ***Conclusion***

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daborah Chacko-Davis whose telephone number is (571) 272-1380. The examiner can normally be reached on M-F 9:30 - 6:00. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you

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have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

dcd

  
March 20, 2007.



MARK F. HUFF  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700